

## TABLE OF RADIOACTIVE ELEMENTS\*

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### I. INTRODUCTION

For those chemical elements which have no stable nuclides with a terrestrial isotopic composition, the data on radioactive half-lives and relative atomic masses for the nuclides of interest and importance have been evaluated and the recommended values and uncertainties are listed.

### II. DISCUSSION

As has been the custom in the past, the International Union of Pure and Applied Chemistry's (IUPAC) Commission on Atomic Weights and Isotopic Abundances publishes a table of relative atomic masses and half-lives of selected radionuclides in its biennial report. The Commission has no prime responsibility for the dissemination of such values.

There is no general agreement on which of the nuclides of the radioactive elements is, or is likely to be judged, "important". Various criteria such as "longest half-life", "production in quantity" and "used commercially", have been applied in the past to the Commission's choice of which nuclide of a particular element to present in the Table.

The information contained in this table will enable the user to calculate the atomic weight for radioactive materials which might have a variety of isotopic compositions. Atomic masses have been taken from the 1997 Atomic Mass Table<sup>1</sup>. Both the half-life values and the uncertainties, which are shown in parentheses in the Table, have been generated from a review of the data published in the open literature. Some of these half-lives presented in the Table have already been documented<sup>2,3,4,5</sup>.

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### III. REVISED DATA

With the recent withdrawl of the 1999 nuclear data supporting the discovery of element 116 and element 118, the entry for element 118 has been eliminated from the accompanying table. There is later information from 2000 that provided nuclear data that supported the discovery of element 116. The entry for element 116 should continue in the accompanying table but with a different mass number and with a lower half-life value. These are the changes which required the revision of this report.

### IV. ACKNOWLEDGEMENT

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### V. REFERENCES

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**Table 1. Masses and Half-lives of Radioactive Nuclides of Elements**

Atomic Number	Element Name	Element Symbol	Mass No.	Atomic Mass	Half-life (Uncertainty)	Units
43	Technetium	Tc	97	96.9064	$4.2(2) \times 10^6$	a
			98	97.9072	$6.6(10) \times 10^6$	a
			99	98.9063	$2.11(1) \times 10^5$	a
61	Prometium	Pm	145	144.9127	17.7(4)	a
			147	146.9151	2.623(3)	a
84	Polonium	Po	209	208.9824	102.(5)	a
			210	209.9829	138.4(1)	d
85	Astatine	At	210	209.9871	8.1(4)	h
			211	210.9875	7.21(1)	h
86	Radon	Rn	211	210.9906	14.6(2)	h
			220	220.0114	55.6(1)	s
			222	222.0176	3.823(4)	d
87	Francium	Fr	223	223.0197	22.0(1)	min
88	Radium	Ra	223	223.0185	11.43(1)	d
			224	224.0202	3.66(2)	d
			226	226.0254	1599.(4)	a
			228	228.0311	5.75(3)	a
89	Actinium	Ac	227	227.0277	21.77(2)	a
90	Thorium	Th	230	230.0331	$7.54(3) \times 10^4$	a
			232	232.0381	$1.40(1) \times 10^{10}$	a
91	Protactinium	Pa	231	231.0359	$3.25(1) \times 10^4$	a
92	Uranium	U	233	233.0396	$1.592(2) \times 10^5$	a
			234	234.0409	$2.455(6) \times 10^5$	a
			235	235.0439	$7.04(1) \times 10^8$	a
			236	236.0456	$2.342(4) \times 10^7$	a
			238	238.0508	$4.47(2) \times 10^9$	a
93	Neptunium	Np	237	237.0482	$2.14(1) \times 10^6$	a
			239	239.0529	2.355(6)	d
94	Plutonium	Pu	238	238.0496	87.7(1)	a
			239	239.0522	$2.410(3) \times 10^4$	a
			240	240.0538	$6.56(1) \times 10^3$	a
			241	241.0568	14.4(1)	a
			242	242.0587	$3.75(2) \times 10^5$	a
			244	244.0642	$8.00(9) \times 10^7$	a
95	Americium	Am	241	241.0568	432.7(6)	a
			243	243.0614	$7.37(2) \times 10^3$	a

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Atomic Number	Element Name	Element Symbol	Mass No.	Atomic Mass	Half-life (Uncertainty)	Units
96	Curium	Cm	243	243.0614	29.1(1)	a
			244	244.0627	18.1(1)	a
			245	245.0655	$8.48(6) \times 10^3$	a
			246	246.0672	$4.76(4) \times 10^3$	a
			247	247.0704	$1.56(5) \times 10^7$	a
			248	248.0723	$3.48(6) \times 10^5$	a
97	Berkelium	Bk	247	247.0703	$1.4(3) \times 10^3$	a
			249	249.0750	$3.26(3) \times 10^2$	d
98	Californium	Cf	249	249.0748	351.(2)	a
			250	250.0764	13.1(1)	a
			251	251.0796	$9.0(5) \times 10^2$	a
			252	252.0816	2.65(1)	a
99	Einsteinium	Es	252	252.0830	472.(2)	d
100	Fermium	Fm	257	257.0951	100.5(2)	d
101	Mendelevium	Md	258	258.0984	51.5(3)	d
			260	260.1037	27.8(3)	d
102	Nobelium	No	259	259.1011	58.(5)	min
103	Lawrencium	Lr	262	262.1097	3.6(3)	h
104	Rutherfordium	Rf	263	263.1125	10.(2)	min
105	Dubnium	Db	262	262.1141	34.(5)	s
106	Seaborgium	Sg	266	266.1219	$\approx 21^{\text{a}}$	s
107	Bohrium	Bh	267	267.1277	$\approx 17^{\text{a}}$	s
108	Hassium	Hs	277		$\approx 11^{\text{a,b}}$	min
109	Meitnerium	Mt	268	268.1388	$\approx 0.070^{\text{a,b}}$	s
110	Ununnilium	Uun	281		$\approx 1.1^{\text{a,b}}$	min
111	Unununium	Uuu	272	272.1535	$\approx 1.5^{\text{a,b}} \times 10^{-3}$	s
112	Ununbium	Uub	285		$\approx 11^{\text{a,b}}$	min
114	Ununquadium	Uuq	289		$\approx 21^{\text{a,b}}$	s
116	Ununhexium	Uuh	292		$\approx 0.033^{\text{a,b}}$	s

<sup>a</sup> The uncertainties of these elements are asymmetric.

<sup>b</sup> The value given is determined from only a few decays.